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Cover

Glorious Debut of Space Shuttle—A totally successful first flight of the mated Boeing 747 carrier jet and orbiter, *Enterprise*, took place at the Dryden Flight Research Center on Feb. 18. Taxi tests preceded the event, all of which were completed at the Mohave Desert's Edwards Air Force Base. The three preliminary taxi tests were performed at speeds of 78, 122 and 137 knots (90 140 and 157 miles per hour). The orbiter weighs 67,500 kilograms (75 tons) and measures 37.2 meters (122 feet). Six captive test flights will be followed by manned captive flights with free flights of the orbiter scheduled to begin in July.

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Letter from Washington

Dear Colleagues:

In this winter of our discomfort, inconvenience, and outright frustration with energy shortages resulting from the big freeze, it seems appropriate to remind ourselves that we at NASA are doing something about it.

Although Apollo, Viking, Pioneer, Skylab and similarly successful and highly visible projects often bring to mind a public image of NASA as operating largely in interplanetary space, our agency is doing a great deal of constructive work here on the ground where we all live. This encompasses work that can eventually lead to an alleviation of the worries of this winter—work in the practical applications of solar energy, specifically solar heating and cooling.

Last year at the Langley center we constructed and opened to the public a three-bedroom home that incorporates maximum use of energy-saving ideas and technological innovations developed from aerospace research. Included are precise heating and cooling control systems; a series of solar collectors on the roof for heat; fire-resistant plastic foam insulation; a high capacity flat conductor electrical cable system; solid-state appliances; and "thermal shutters" to reduce heat loss through windows. It has, among other things, a waste-water reclamation system that collects water used in sinks, bathtubs, showers and laundry and recycles it for use in toilet flushing; and heat pipe systems to recapture waste heat from the water storage tank and from other sources. NASA program managers estimate that a family of four living in this house will use only a third as much fuel as is now considered average.

Also at the Langley center, a new 4,894 square-meter (53,000 square-foot) office building is presently deriving three-quarters of its heating and cooling from an experimental 1,196 square-meter (13,000 square-foot) solar collector system composed of seven different collector designs from five manufacturers.

If those two developments could be extended to all homes and office buildings in the United States, eventual savings are estimated at three to four billion dollars per year.

NASA has invested half a million dollars in partnership with ERDA for 10 cooperative solar heating projects at various NASA facilities. For example, the Sun's energy will supply: hot water for cafeterias at the Dryden and Kennedy centers; hot water for the photo labs at the Ames and Langley centers; and heating and dehumidification for rooms housing sensitive equipment at the Johnson center.

At the Marshall center, engineers are managing more than 30 solar heating and cooling commercial projects that use the Sun's energy to heat such diverse structures as an office building, a warehouse, a school, a motel, a factory, a fire station, and a laundry. More than 100 people at Marshall are devoting their efforts to solar heating and cooling projects.

As our country has been forced by the 1976-77 weather into a keen awareness of energy requirements in the area of heating, I think it is important to remember that NASA— along with other government agencies—is working hard to develop untapped energy sources for other uses. In addition to sums mentioned earlier, $37million and the efforts of 140 NASA people at the Lewis center and at the Jet Propulsion Laboratory are being dedicated to solar energy programs, with an emphasis on wind-powered turbo generators and photovoltaics (direct generation of electricity from solar radiation). At our National Space Technology Laboratories, scientists are looking into the potential ability of aquatic plants to produce methane gas for use as fuel.

In an effort to further develop another system, NASA is working with ERDA and General Electric to construct two windmills of unprecedented size that will generate 1,500 kilowatts each.

In another energy-related effort, the Lewis center has conducted aerial thermal infrared scans of NASA field centers which have resulted in an estimated $235,000 direct energy saving for NASA. This

estimate is based on a recent field center survey of repairs, structural changes, and operating procedures initiated to eliminate excessive heat losses discovered by infrared scans. Since the entire infrared scanning program, including data processing, cost only $94,000, it is estimated that another $230,000 has been saved by using aerial thermal scans instead of the more costly conventional heating system surveys.

As Space Shuttle operations begin, we will have another capability—that of constructing satellite solar power stations in Earth orbit some seven miles long and three miles wide. These huge arrays of solar cells—weighing on Earth about 40 million pounds—would gather the solar energy and transmit it to Earth by microwave for reconversion to electrical energy and distribution through established networks. It is difficult to imagine a cleaner, more dependable, or more inexhaustible source of electrical power. NASA planners believe that a pilot, prototype system could be functional by 1990, a commercial unit by 1995, and that two to four could be deployed each year thereafter. NASA teams at the Johnson center, the Marshall center and the Boeing Aerospace Company are making in-depth studies of this possible major source of the nation's future power needs.

Many of us feel that the potentially inexhaustible power of the Sun may provide the answer to man's energy needs in the future. All of us at NASA should be proud that we are making steady progress in such useful directions.

Sincerely,

James C. Fletcher

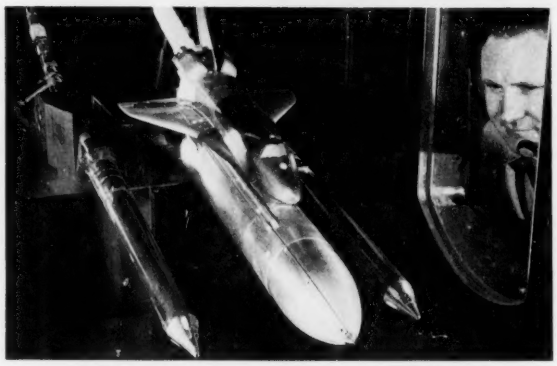
Shuttle Orbiter 101 Arrives at Dryden

Traveling at a speedy three to five m.p.h., the *Enterprise* crept across some 56 kilometers (36 miles) of the Mohave Desert from the Rockwell International Corporation's Space Division in Palmdale, Calif., to the Dryden Flight Research Center, last January.

The 68,000 kilogram (75-ton) spacecraft was moved on a special highway transporter over a road that had been altered to accommodate the wide, heavy vehicle. Many sightseers lined the route to watch the uncommon event.

After its arrival at Dryden, the orbiter was mated with the modified Boeing 747 aircraft that will carry the spacecraft in piggyback fashion to its testing destination. Runway taxi tests of the vehicles began in February followed by two checkout flights. A series of approach and landing tests are expected to run into July before the *Enterprise's* first crewed free flight takes place. Following the free flight tests, the orbiter will be ferried by the Boeing 747 to the Marshall center in March 1978 for ground vibration tests.

Oddity on the Desert Landscape—The *Enterprise* is silhouetted against the hilly terrain of the Mohave Desert in California as it is transported to the Dryden Flight Research Center. In forthcoming flight tests, the Space Shuttle orbiter will be airlaunched from aboard a specially equipped Boeing 747 aircraft.



Shuttle Separation Studies—A test facility craftsman at the Air Force Systems Command's Arnold Engineering Development Center (Tennessee) conducts a pre-test check of the dual support system that controls separation of two solid rocket boosters from the Space Shuttle orbiter and external tank. The AEDC is conducting separation tests of the recoverable and reusable boosters for the Johnson Space Center.

NATO III-B Is Launched

The second in a new series of communications satellites to serve the North Atlantic Treaty Organization was launched by NASA's Kennedy Space Center from Cape Canaveral on Jan. 27.

The spacecraft was placed by a Delta launch vehicle into an elliptical transfer orbit with an apogee of 35,785 kilometers (22,235 miles) and a perigee of 185 km (115 mi.). It inclines 27 degrees to the equator.

After NATO III-B went into the transfer orbit, the U.S. Air Force Satellite Control Facility Network took control on NATO's behalf. About two days later, on about the fifth apogee, SCF operators correctly aimed the spacecraft and fired an onboard solid propellant kick motor to circularize the orbit and change its inclination to above the equator.

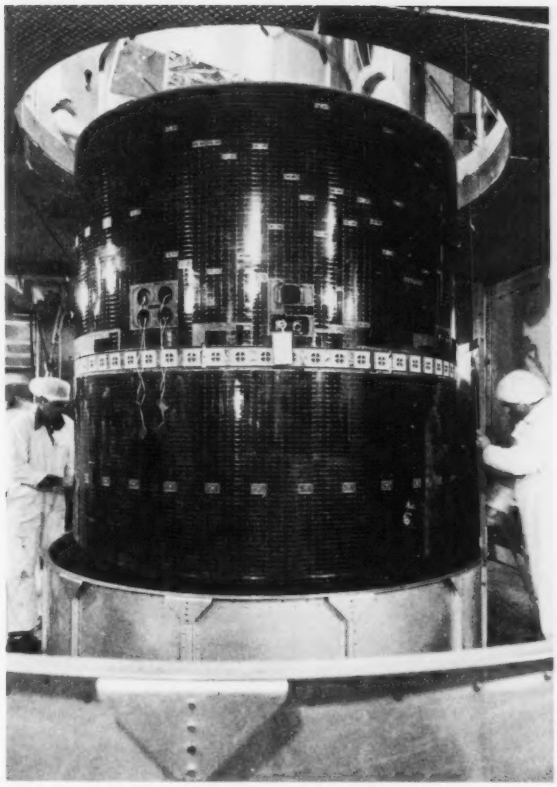
In this circular orbit the satellite drifts until an onboard reaction control system stabilizes it at a predetermined location. After that, the spacecraft stays at an altitude of 35,900 km (22,300 mi.) traveling at a speed of 11,066 km per hour (6,876 mi. an hour). At this height and velocity its movement becomes "synchronized" with that of the Earth below so that it appears to remain stationary in the sky.

NATO III-B is the second of three NATO Phase-III spacecraft designed to replace the NATO-II satellites in the NATO Integrated Communications Systems (NICS). The three spacecraft are funded entirely by NATO and were built by Ford Aerospace and Communication Corp. at Palo Alto, Calif. They are launched by NASA from Complex 17 at the Cape Canaveral Air Force Station, Fla., on NASA Delta 2914 launch vehicles.

The U.S. Air Force Space and Missile Systems Organization serves as the satellite contracting agency on behalf of the NATO Integrated Communications System Management Agency.

The third NATO III is scheduled for launch in 1978. NATO reimburses the United States for the cost of the launch vehicles and launch services.

NASA's Goddard Space Flight Center provided the Delta rocket to launch NATO III-B. McDonnell Douglas Astronautics Co. of Huntington Beach, Calif., manufactures the Delta. Three previous NATO satellites were launched successfully by Delta. These were the NATO II-A and B launched in March 1970 and February 1971, and NATO III-A in April 1976.



Close-up View of NATO III-B—Kennedy Space Center personnel check out the first spacecraft to be sent aloft in 1977 just before launch from the Cape Canaveral Air Force Station aboard a Delta rocket on Jan. 27. The communications satellite is reimbursable.

AIDSAT May Spur More International Programs

NASA and the Agency for International Development have established a joint working group to explore additional cooperative international programs following successful completion of the AIDSAT project. AIDSAT, a joint NASA-AID venture, ended Oct. 30 with a final program in Haiti. The project demonstrated to people in 27 developing nations how space and other advanced technologies can improve their way of life. NASA's Applications Technology Satellite (ATS-6) served as the primary disseminating point in the two-part program, which began last Aug. 1. A major feature of the versatile satellite is its ability to broadcast high quality color television from small, portable transmitters directly to low-cost receivers in remote areas.

The first part of the program included demonstrations in countries in southeast and south Asia, the

Middle East, and in East and North Africa. The second part involved countries in West Africa, South and Central America and the Caribbean. Participants in the program included eight presidents, three prime ministers, a king, a sultan, and many top-ranking ministers and businessmen in the host countries.

Millions of viewers watched the programs by direct or delayed taped broadcasts over national television networks. Demonstration broadcasts often were the first ever received in color in the host country. Sometimes the demonstration presented the first opportunity for a nationwide television hookup in the participating country.

NASA technicians set up one transmitter-receiver unit in the capital of each participating country. Programs consisted of filmed and live material. The filmed portion presented an address by former President Ford, followed by three films produced for AIDSAT by NASA.

The first film, "If One Today, Two Tomorrow," was about communications technology. The second, "Images of Life," dealt with remote sensing satellite capabilities (Landsat), and it recently won the Gold Medal for Science and Technology Films at the International Film and TV Festival in New York. Predictions of natural disasters and aid to disaster-torn areas were the subjects of the third film, "Survival."

The live segment of the demonstration consisted of two 30-minute programs. The first, originating in the host country, featured ministers and officials outlining current technological challenges facing their nation and efforts being made to meet those challenges.

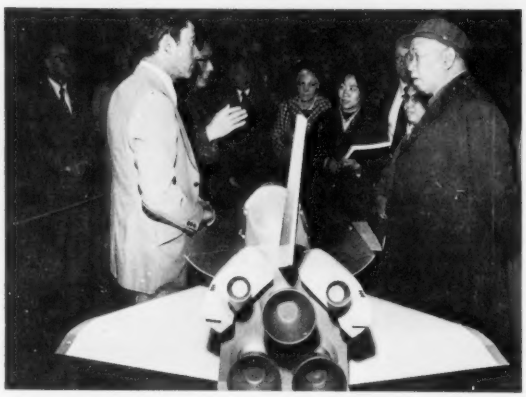
The second portion was a two-way television question-and-answer session between a panel of senior government officials in each host country and selected experts in Washington. Panel members were conversant with subjects such as communications, education, health, forestry, planning, agriculture, hydrology and geology. Questions posed by the host country and panelists were generated by technical subjects in the films as they related to each country.

For the 12 programs of Phase I, the communications systems combined commercial audio and video surface lines, commercial satellite links and the ATS-6 for the two-way portion of the broadcast. For Phase II, the communication links consisted of commercial audio and video lines to the Rosman, N.C., tracking station for communication through ATS-6 to and from the remote sites.

AID officials were pleased with the responses received as a result of the program and are evaluating opportunities to follow up the technological interest in the host countries. Typical of favorable responses received were the remarks of Jamaica's Prime Minister Michael Manley, who said: "The gap that prevents men and women of different countries at different stages of development with different languages, cultures and life styles will only begin to close when we begin to communicate honestly and effectively with each other . . . we appreciate the effort being made by the United States to acquaint countries like ours with the latest advances in satellite technology."

The project was the first step in fulfilling a pledge made by the U.S. government to help developing countries through applications of advanced technology. Former Secretary of State Henry A. Kissinger, addressing the U.S. Conference on Trade and Development last May in Nairobi, Kenya, emphasized how use of satellite technology might improve cooperation between industrialized and developing nations.

Countries participating in the AIDSAT project were Thailand, Bangladesh, Pakistan, United Arab Emirates, Oman, Jordan, Yemen, Kenya, Libya, Sudan, Morocco, Mali, Cameroon, Central African Republic, Ivory Coast, Upper Volta, Mano River Union (Sierra Leone and Liberia), Peru, Argentina, Bolivia, Uruguay, Ecuador, Surinam, Costa Rica, Jamaica and Haiti.



Chinese Official Briefed—His Excellency Huang Chen (right) chief of the U.S. Liaison Office of the People's Republic of China, listens intently as an interpreter translates an explanation of the Space Shuttle orbiter by Astronaut chief John Young, at left. Huang, who served as first ambassador to France from the People's Republic from 1964 to 1973, recently visited the Johnson Space Center.

Newly Elected Club Officials—The NASA Employees' Club at headquarters recently installed a slate of officers for the 1977-79 term. Standing with Associate Administrator Todd Groo (third from left) are, left to right: Bill Hayden, president; Pat Newçomer, vice president; Ruby Pelton, social activities; Egon Kafka, athletic activities; Sandy Conrad, cooperative activities; and Myron Nagurney, treasurer. Zenobia Yancey was elected secretary and Tony Cannetti is store manager.

New Program Leader at Kennedy

Pat Lowry has been named the new coordinator for the Federal Women's Program at the Kennedy Space Center, succeeding Mae Waterhouse, who is on assignment at NASA headquarters for a year. Previously, Lowry was an administrative specialist with the technical support directorate, an organization for which she has worked since 1966.

Because she is extremely interested in and dedicated to the advancement of women in today's society, Lowry has been active in a number of women's organizations. A member of the Space Coast Chapter of Federally Employed Women, she has held several offices, including that of president. She was an officer in the Brevard Community College Faculty Women's Club and a member of the Brevard County Equal Rights Amendment Coalition for five years. In addition to her regular duties, Lowry served for two-and-a-half years as an EEO counselor at the Kennedy center. She was chosen as the 1976 member-of-the-year by the Space Coast Chapter of FEW.

Lowry says she plans to continue some of the programs initiated by her predecessor, including the "Brown Bag Lunch Study Program," which offers college courses during employee lunch periods.

Shuttle Carrier Aircraft Returned to NASA

The Boeing 747 to be used to carry the Space Shuttle Orbiter during approach and landing tests returned to NASA's Dryden Flight Research Center on Jan. 14.

The Shuttle carrier aircraft underwent modification by the Boeing Company to enable it to carry the 68,000-kilogram (150,000-pound) orbiter. In addition to the structural modifications designed to increase the 747's ability to carry the additional weight of the orbiter, three mounts were installed on top of the aircraft. Because the mated orbiter will disturb the air-flow around the plane's vertical tail, two smaller stabilizers were installed on the tips of the horizontal tail.

The aircraft made two checkout flights at Dryden before beginning pre-flight preparations for approach and landing tests, whose purpose is to check out radar, telemetry, communications and monitoring facilities on a real-time basis. The two flights were under the control of the same NASA ground stations at Dryden that will be used during the initial flight tests.

Team for Extraordinary Tests—NASA Dryden Flight Research Center test pilots Thomas McMurtry and Fitzhugh Fulton, Jr., and flight engineer Victor Horton (left to right) will fly the 747 carrier aircraft for the space shuttle approach and landing tests. The Space Shuttle Orbiter will be air-launched from its piggyback position on the 747 as shown on the model in the picture.

Prospectus

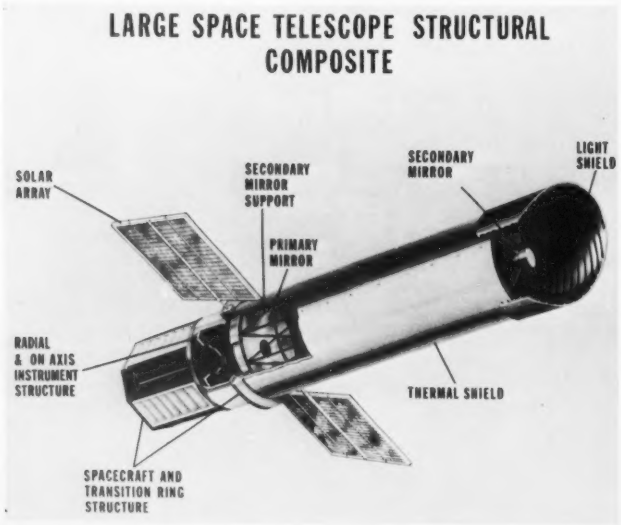
The 1978 Budget

The fiscal year 1978 budget contains few surprises but it does affirm four initiatives that illustrate the excitement and diversity of our space programs. Most of the funding request is preordained. The Space Shuttle project, of course, is already underway as the logical progression from the three-phase commitment to land on the Moon and subsequent near-Earth missions. Glide approach testing and simulated landings of the first Shuttle orbiter begin this year and the first orbital flight is set for 1979. But the budget, as revealed by Dr. James C. Fletcher in January, also incorporates new starts that will be operational during the rest of this decade and the first part of the next.

One program carries on the continuous work of deep space exploration, exemplified by the successful Viking landings of 1976. It is the Jupiter Orbiter Probe, scheduled for 1981-82, which will take another look at a planet, its environment and its satellites. The flight time is 1,050 days; 56 days before the spacecraft reaches Jupiter, the entry Probe will be released from the orbiter. As with the Martian system last year, the orbiter will serve as a relay link to Earth, passing on the data gathered by the Probe telemeters. All the activity related to information collecting and processing will employ the NASA Deep Space Network, the Communications Network and Mission Control and Computing Center facilities operated by the NASA Jet Propulsion Laboratory, in yet another facet of the remarkable job that the California facility performed during the Viking missions.

At the same time, NASA will maintain its Earth benefit enterprises, formally establishing an operational Earth resources survey program. The Landsat satellites already in orbit and functioning will be reinforced in the near future. Landsat-C is to be launched later this year and the White House Science Advisor announced that Landsat-D is included in the budget submitted to Congress. Here again is one of the great opportunities to make space pay its way, benefitting the people of our nation with data on crop measurement, environmental monitoring and mineral exploration. Landsats and related missions affect the spectrum of human life and work—encompassing both conservationists and extractors, the foreign policy makers and the vital domestic economy.

From this tiny globe, we will keep an eye on the universe and make calculations that were impossible before. In the budget breakdown is the Space Telescope (ST) section. Using the Shuttle, we will place in orbit the large instrument that will provide us with astronomical observations deep in the galaxy. The Shuttle orbiter also will reposition and service the telescope as required. The ST, with its 2.4-meter lens, becomes operational in the early 1980s and will extend our view seven times farther



into space than at present; we can investigate quasars and individual stars outside our galaxy and possibly determine if nearby stars have planetary systems. The instrument will bring to us facts that truly boggle the mind and enrich the scientific knowledge that we possess. For instance, the light coming from distant stars takes over 10 billion years to reach us. At present, the five-meter Hale telescope at Palomar Mountain, Calif., can see an estimated two billion light years, or about 12 billion trillion miles into the galaxy. The ST will observe events that happened 10 billion years ago, about the time it takes for starlight to come to Earth, or almost to the beginning of the universe. The date for the ST's launch via the Shuttle is early in 1983.

But again we return to the use of space as related to human existence and in one particular budget clause, safety and life or death. About 3,750 Americans confront distress situations every year and they must be rescued. The victims represent some one-tenth of the world's distress calls, involving aircraft and maritime incidents. Overall, something like 45,000 individuals of all nationalities are in distress during a year and have to be rescued by various means. Now, NASA has produced a Global Rescue Locator, working in close conjunction with the Maritime Administration, the FAA, the Department of Transportation (in particular its Coast Guard branch), the FCC, Air Force and private groups and associations. This innovation is based on the use of satellites at a very low cost. For example, a small radio, no bigger than a Dick Tracy wristwatch communicator, could send signals from a life raft or a downed aircraft which would be instantly transmitted to sea and air rescue units.

All these plans are fresh and stimulating, even though they have been germinating for some time. From the reaches of space to land and its inhabitants, each represents a new plateau in the continuous march of NASA progress. Yet, when the budget was unveiled, Dr. Fletcher stressed that the funding was well within bounds. In his words, "It carries forward the nation's research and development program in space and aeronautics along the directions of long-range planning as presented in previous years. It is in line with last year's projections, and in overall terms, just about keeps abreast of anticipated inflation." ■■■

NASA Grant Helps Establish Electronics Laboratory

A grant of $150,000 recently was provided to the North Carolina A&T State University by NASA's Office of University Affairs through the Langley Research Center. Purpose of the grant was to permit the university to conduct research on gallium arsenide solar cells, a project that represents the first technical study in a new solid state electronics laboratory located at the university's Greensboro, N.C. site.

The electronics laboratory stems from sponsorship of a developmental program by the Rockwell International Corporation (through its Science Center) at the predominantly black N.C. university. The purpose of the effort is to establish strong research capabilities in the area of opto-electronics, which can provide a core program for producing minority scientists and engineers with advanced degrees.

The new laboratory was dedicated last Feb. 1.

Appreciation Expressed—James F. Connors (holding plaque) shakes hands with Buck Fernandez, Assistant Associate Administrator for Center Operations, as Connors accepts a NASA Award of Appreciation. At far left is E. Barton Geer, director of systems engineering and operations at the Langley center and outgoing chairman of the technical operations panel. On Connors' right is Aleck Bond, Assistant Director of Program Support at the Johnson Space Center, the newly appointed chairman of the technical operations panel. (The panel is made up of senior managers from NASA centers and headquarters, to provide a link between the two.) The award, signed by NASA headquarters' Todd Groo, cited Connors' "long and outstanding service to NASA as the first chairman of the OAST safety and operating panel and valued member of the NASA technical operations panel." Connors has been with Lewis for 32 years. An expert in supersonic propulsion aerodynamics, he has spent most of his 32-year NASA career in studies of propulsion wind tunnels. Connors for the past seven years has held management responsibility for all technical support operations at Lewis. He is the author of some 55 technical publications.

NASA Budget Plan For Fiscal Year 1978

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

BUDGET SUMMARY
(Thousands of Dollars)

BUDGET PLAN	FY 1976	Transition Quarter	FY 1977	FY 1978
Research and development	2,677,380	700,600	2,761,425	3,011,000
Construction of facilities	82,130	10,750	118,090	161,800
Research and program management	792,312	220,169	844,777[a/]	846,989
TOTAL BUDGET PLAN	3,551,822	931,519	3,724,292	4,019,789
OUTLAYS	3,669,022	951,428	3,705,750	3,902,789

a/ Includes proposed supplemental of $31,777,000 to cover increased salary rates effective October 1976.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND DEVELOPMENT PROGRAMS

BUDGET PLAN
(Thousands of Dollars)

	FY 1976	Transition Quarter	FY 1977	FY 1978
SPACE FLIGHT	1,560,574	406,500	1,641,700	1,753,500
Space shuttle	1,206,000	321,000	1,288,100	1,349,200
Space flight operations	188,674	48,400	202,200	267,800
Expendable launch vehicles	165,900	37,100	151,400	136,500
SPACE SCIENCE	434,126	116,400	380,325	405,700
Physics and astronomy	159,300	43,500	166,300	224,200
Lunar and planetary exploration	254,250	67,464	191,900	148,200
Life sciences	20,576	5,436	22,125	33,300
APPLICATIONS	178,230	47,700	198,200	228,800
AERONAUTICS AND SPACE TECHNOLOGY	250,250	63,100	272,100	328,700
Aeronautical research and technology	175,350	43,800	190,100	231,000
Space research and technology	74,900	19,300	82,000	97,700
ENERGY TECHNOLOGY APPLICATIONS	5,900	1,500	6,000	4,500
TRACKING AND DATA ACQUISITION	240,800	63,400	255,000	281,700
TECHNOLOGY UTILIZATION	7,500	2,000	8,100	8,100
TOTAL	2,677,380	700,600	2,761,425	3,011,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE FLIGHT

BUDGET PLAN
(Thousands of Dollars)

	FY 1976	Transition Quarter	FY 1977	FY 1978
SPACE SHUTTLE	1,206,000	321,000	1,288,100	1,349,200
Design, Development, Test and Evaluation	(1,206,000)	(321,000)	(1,288,100)	(1,207,500)
Orbiter	867,335	216,300	854,100	690,500
Main engine	140,800	17,900	178,400	219,900
Solid rocket boosters	65,700	20,400	90,800	83,600
External tanks	82,240	26,000	76,000	80,000
Launch and landing	49,925	20,400	88,800	133,500
Production initiation of production to provide five orbiter fleet	---	---	---	141,700
SPACE FLIGHT OPERATIONS	188,674	48,400	202,200	267,800
Development, test and mission operations	161,100	40,800	166,900	173,000
Space transportation system operations capability development	11,300	2,840	18,800	63,000
Space transportation system operations	---	---	---	17,800
Advanced programs	12,074	3,500	13,000	10,000
Planning and program integration	4,200	1,260	3,500	4,000
EXPENDABLE LAUNCH VEHICLES	165,900	37,100	151,400	136,500
Scout	10,600	3,400	10,700	16,000
Centaur	110,100	24,400	90,700	55,900
Delta	41,800	9,300	43,800	55,300
Atlas F	3,400	---	6,200	9,300
TOTAL SPACE FLIGHT	1,560,574	406,300	1,641,700	1,753,500

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SCIENCE

BUDGET PLAN
(Thousands of Dollars)

	FY 1976	Transition Quarter	FY 1977	FY 1978
PHYSICS AND ASTRONOMY	159,300	43,500	166,300	224,200
High energy astronomy observatories	59,218	14,510	39,362	22,450
Solar maximum mission	---	---	21,300	30,600
Space telescope	---	---	---	36,000
Shuttle/Spacelab payload development	1,100	2,600	6,000	28,900
Orbiting explorers	29,922	6,500	30,238	35,000
Solar observatories	3,600	625	1,000	1,270
Astronomical observatories	2,300	490	2,600	1,980
Suborbital programs	24,800	7,500	26,000	26,000
Upper atmospheric research	3,500	1,000	11,600	11,600
Supporting activities	34,860	10,275	28,200	30,400
LUNAR AND PLANETARY EXPLORATION	254,250	67,464	191,900	148,200
Viking	39,500	11,600	25,400	20,000
Pioneer Venus	56,600	15,300	42,800	19,000
Mariner Jupiter/Saturn 1977	82,400	22,100	50,300	14,300
Jupiter Orbiter/Probe	---	---	---	20,700
Pioneer 6-11	3,900	879	2,600	3,600
Helios	1,200	200	900	700
Planetary flight support	29,200	8,700	27,900	25,000
Supporting activities	41,450	8,685	42,000	44,900
LIFE SCIENCES	20,576	5,436	22,125	33,300
Common operating research equipment	1,000	500	1,500	8,000
Vestibular function research	---	---	900	1,500
Integrated life sciences shuttle/spacelab experiments	---	---	---	1,000
Supporting activities	19,576	4,936	19,725	22,800
TOTAL, SPACE SCIENCE	434,126	116,400	380,325	405,700

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE APPLICATIONS

BUDGET PLAN
(Thousands of Dollars)

	FY 1976	Transition Quarter	FY 1977	FY 1978
EARTH RESOURCES DETECTION AND MONITORING	60,600	12,978	64,700	92,000
LANDSAT - 1 & 2	5,100	---	---	---
LANDSAT-C	13,000	3,500	13,500	3,200
Thematic Mapper	---	---	4,000	14,800
LANDSAT-D	---	---	---	21,900
Applications transfer and demonstration program	10,400	2,500	13,900	13,400
Applications research and technology development and related activities	32,100	6,978	33,300	33,000
Shuttle/Spacelab payload development and mission integration	---	---	---	5,700
EARTH RESOURCES OPERATIONAL SYSTEMS				
Study of potential future operational systems	---	---	200	---
EARTH DYNAMICS MONITORING AND FORECASTING	8,000	1,900	4,900	7,900
Tectonic plate motion	2,600	700	1,900	2,200
Applications research and technology development and related activities	5,400	1,200	3,000	5,700
OCEAN CONDITION MONITORING AND FORECASTING	22,200	8,100	30,800	19,200
SEASAT-A	15,800	6,000	25,300	11,400
Applications research and technology development and related activities	6,400	2,100	5,500	7,800
ENVIRONMENTAL QUALITY MONITORING	22,000	9,039	27,200	27,500
NIMBUS-G	13,000	6,700	15,400	14,700
Applications research and technology development and related activities	9,000	2,339	11,000	10,200
Shuttle/Spacelab payload development	---	---	800	2,600
WEATHER AND CLIMATE OBSERVATION AND FORECASTING	40,630	9,783	36,700	30,700
NIMBUS - 5 & 6	5,700	---	---	---
TIROS-N	8,000	2,100	10,100	2,100
Global atmospheric research program	7,000	1,800	5,100	5,000
Severe storm research program	7,900	2,200	8,000	6,500
Applications research and technology development and related activities	12,030	3,683	13,500	14,400
Shuttle/Spacelab payload development	---	---	---	2,700

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

AERONAUTICS AND SPACE TECHNOLOGY

BUDGET PLAN
(Thousands of Dollars)

	FY 1976	Transition Quarter	FY 1977	FY 1978
AERONAUTICAL RESEARCH AND TECHNOLOGY	175,350	43,800	190,100	231,000
Research and technology base	84,659	21,035	89,140	97,550
Systems studies	2,716	560	2,935	3,000
Systems technology programs	42,251	13,084	57,145	72,200
Experimental programs	45,724	9,121	40,880	58,250
(Aircraft energy efficiency technology included in systems technology and experimental programs)	(9,475)	(4,837)	(39,550)	(70,200)
SPACE RESEARCH AND TECHNOLOGY	74,900	19,300	82,000	97,700
Research and technology base	60,560	15,745	61,610	65,900
Systems studies	2,025	325	2,000	2,000
Systems technology programs	2,020	645	3,080	5,800
Experimental programs	4,195	1,085	7,010	15,000
Low cost systems program	6,100	1,500	8,300	9,000
TOTAL AERONAUTICS AND SPACE TECHNOLOGY	250,250	63,100	272,100	328,700

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE APPLICATIONS (Cont'd)

BUDGET PLAN
(Thousands of Dollars)

	FY 1976	Transition Quarter	FY 1977	FY 1978
MATERIALS PROCESSING IN SPACE	5,900	1,100	8,900	15,500
Applications research and technology development and related activities	5,900	1,100	8,900	9,200
Shuttle/Spacelab payload development	---	---	---	6,300
SPACE COMMUNICATIONS	13,000	2,600	15,500	22,800
Cooperative Applications Satellite (CAS-C)	1,100	100	300	100
Search and rescue satellite system	---	---	---	5,600
Applications transfer and demonstration program	---	---	900	900
Applications research and technology development and related activities	11,900	2,500	13,100	14,000
Shuttle/Spacelab payload development	---	---	1,200	2,200
APPLICATIONS EXPLORER MISSIONS	5,900	2,200	9,300	13,200
TOTAL APPLICATIONS	178,230	47,700	198,200	228,800
Space Applications	(178,230)	(47,700)	(198,000)	(228,800)
Earth Resources Operational systems	(---)	(---)	(200)	(---)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

OTHER BUDGET ACTIVITIES

BUDGET PLAN
(Thousands of Dollars)

	FY 1976	Transition Quarter	FY 1977	FY 1978
ENERGY TECHNOLOGY APPLICATIONS				
ENERGY TECHNOLOGY APPLICATIONS	5,900	1,500	6,000	4,500
TRACKING AND DATA ACQUISITION				
TRACKING AND DATA ACQUISITION	240,800	63,400	255,000	281,700
Operations	192,536	50,400	203,600	229,900
Systems implementation	39,043	10,700	42,700	42,500
Advanced systems	9,221	2,300	8,700	9,300
TECHNOLOGY UTILIZATION				
TECHNOLOGY UTILIZATION	7,500	2,000	8,100	8,100

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1978 CONSTRUCTION OF FACILITIES PROGRAM

BUDGET PLAN
(Thousands of Dollars)

PROJECTS BY INSTALLATION

Dryden Flight Research Center	420
Construction of central hydraulic system	420
Goddard Space Flight Center	3,100
Construction of additional technical processing facilities	3,100
Jet Propulsion Laboratory	2,830
Modifications to various buildings for seismic protection	2,830
Johnson Space Center	2,540
Modification of chillers in central heating and cooling plant	2,540
Kennedy Space Center	2,130
Modifications for utility control system	2,130
Langley Research Center	1,770
Rehabilitation of main heating plant	790
Rehabilitation of unitary plan wind tunnel	980
Lewis Research Center	860
Modification of central chilled water system	860
National Space Technology Laboratories	620
Modifications for utility control system	620
Large Aeronautical Facilities	37,000
Construction of national transonic facility (LaRC)	23,500
Modification of 40x80-foot subsonic wind tunnel (ARC)	13,500
Various Locations	1,750
Rehabilitation and modification of 64-meter antenna components	1,750
Space Shuttle Facilities	65,740
Modifications to launch complex 39 (KSC)	40,700
Modifications for solid rocket booster processing facilities (KSC)	1,730
Rehabilitation of barge channels (KSC)	2,700
Modifications for crew training facilities (JSC)	860
Modification of manufacturing and final assembly facilities for external tanks (MAF)	18,610
Rehabilitation and modification of shuttle facilities at various locations	1,750

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND PROGRAM MANAGEMENT

BUDGET PLAN
(Thousands of Dollars)

INSTALLATION	FY 1976	Transition Quarter	FY 1977	FY 1978
Johnson Space Center	128,817	37,470	139,743	139,581
Kennedy Space Center, NASA	99,794	28,610	107,027	110,141
Marshall Space Flight Center	132,799	35,709	138,557	134,693
National Space Technology Laboratories	1,752	444	1,917	1,942
Goddard Space Flight Center	108,580	28,626	115,872	116,133
Wallops Flight Center	13,081	3,985	13,899	14,226
Ames Research Center	50,964	13,285	53,673	53,706
Dryden Flight Research Center	14,512	5,319	17,267	17,034
Langley Research Center	93,169	24,187	95,414	95,411
Lewis Research Center	80,677	22,214	87,538	88,706
NASA Headquarters	68,167	20,320	73,870	75,416
TOTAL	792,312	220,169	844,777[a]	846,989

a/ Includes proposed supplemental of $31,777,000 to cover increased salary rates effective October 1976.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1978 CONSTRUCTION OF FACILITIES PROGRAM

BUDGET PLAN
(Thousands of Dollars)

PROJECT BY INSTALLATION

Space Shuttle Payload Facility	6,410
Modifications and addition for shuttle payload vertical processing (KSC)	6,410
Rehabilitation and Modification	18,900
Minor Construction	5,950
Facility Planning and Design	11,780
TOTAL PLAN	161,800

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND PROGRAM MANAGEMENT

TOTAL NUMBER OF PERMANENT POSITIONS

END OF YEAR

INSTALLATION	FY 1976	FY 1977	FY 1978
Johnson Space Center	3,613	3,613	3,613
Kennedy Space Center, NASA	2,259	2,259	2,259
Marshall Space Flight Center	4,115	3,910	3,910
National Space Technology Laboratories	70	70	70
Goddard Space Flight Center	3,752	3,675	3,625
Wallops Flight Center	415	414	413
Ames Research Center	1,676	1,613	1,601
Dryden Flight Research Center	498	520	520
Langley Research Center	3,321	3,172	3,165
Lewis Research Center	3,025	3,025	3,025
NASA Headquarters	1,572	1,545	1,536
TOTAL	24,316	23,816	23,737

To Measure Density—A precision quartz ball to be used by the U.S. National Bureau of Standards as a density measure is shown being checked for roundness in an electronic measuring device at the Marshall center. The precision sphere was manufactured for the bureau by John Rasquin (left) and Jack Reed, of MSFC's materials and processes laboratory. The device works on the principle that if the density of one pure substance is known by the Bureau, then the density of all other substances can be related to it.

Launch Schedule for 1977

Of 23 space launches scheduled for 1977, 17 will be for paying customers. These include NATO, Indonesia, the European Space Agency, the National Oceanic and Atmospheric Administration (Commerce Dept.), COMSAT Corp., RCA, the U.S. Navy, Japan, Italy, and the United Kingdom. The customers will reimburse NASA for the costs of the launch vehicles and associated launch services.

The 1977 launch schedule underscores NASA's continuing emphasis on the use of space for the benefit of people on Earth. Seventeen of the planned missions are in the applications satellite category, encompassing communications, geodetic survey, the environment, navigation, meteorology and Earth resources.

The first satellite launched in 1977 was NATO-3B, a North Atlantic Treaty Organization communications spacecraft. Launch was from the Kennedy Space Center in late January, atop a Delta booster. Originally scheduled in December of 1976, the launch was postponed to provide additional time for testing of the spacecraft at the manufacturer's plant.

Palapa-B (Palapa-2 once in orbit), second of two communications satellites to be launched by NASA from KSC for the Indonesian government, is scheduled for launch on a Delta in March. The satellite will expand Indonesia's domestic communications system initiated last year by Palapa-1, now on station over the Pacific Ocean. It provides television, telephone and data communications between Jakarta, the capital city, and Indonesia's 26 provinces.

The first of three High Energy Astronomy Observatories, on an Atlas Centaur, is scheduled for launch in April from KSC. Using a combination of charged particle detectors and the Earth's magnetic field as a mass spectrometer, HEAO will separate the isotopes of cosmic rays and obtain information on the origin of the rays and how they are changed as they propagate through instellar space. Additional HEAO launches are scheduled in 1978 and 1979.

GEOS/ESA (Geodynamic Experimental Ocean Satellite-D) will be launched on a Delta for the European Space Agency from KSC in April. The satellite will test the effectiveness of newly developed instruments in monitoring ocean topography and observing sea state.

GOES-B/NOAA, a Geostationary Operational Environmental Satellite-B, will be launched on a Delta in May from KSC for NOAA. The satellite carries improved instrumentation for monitoring weather patterns. It will join sister satellites SMS-1, SMS-2 and GOES-1 in geosynchronous orbit.

OTS/ESA (Orbital Test Satellite) will be launched at KSC on a Delta in June. The spacecraft, carrying advanced experimental communications systems, will be inserted into geosynchronous orbit over the equator at 10 degrees East longitude for the European Space Agency. A backup satellite can be readied for December launch.

Sky Detective—The "mini-sniffer" recently completed a shakedown flight from its base at the Dryden Flight Research Center. The small, remotely piloted aircraft was conceived by Robert Dale Reed (seen in photo), engineer and chief of advanced project planning at Dryden. It has a wingspan of nearly seven meters (22 feet) and can fly to 6,100 meters (22,000 feet) high as its instruments measure turbulence and pollutants (both natural and manmade) in the atmosphere. This craft and other remotely piloted research vehicles are "flown" by a pilot in a ground-based cockpit. Controls in the cockpit are linked by radio to the control mechanism of the plane.

Intelsat IV-A communications satellite, the first of two launches for the International Telecommunications Satellite Organization, is scheduled in June from KSC aboard an Atlas Centaur. A second Intelsat will be launched in October.

Navy-19 is the first of two Scout launches from the Western Test Range at Vandenberg Air Force Base, Calif. This and Navy-20, planned for call-up in December, will place navigational satellites in Earth orbit.

GMS/Japan (Geostationary Meteorological Satellite) will be launched on a Delta from KSC for the Japanese Space Agency in July. The spacecraft will become the Japanese portion of a global network of environmental satellites.

Sirio/Italy, an experimental communications satellite, will be launched for the Italian government on a Delta at KSC in August. It will be inserted into a geosynchronous orbit at 15 degrees West longitude.

Meteosat/ESA, the European Space Agency's first meteorological satellite, is scheduled for launch on a Delta in August at Kennedy.

Two Mariner Jupiter Saturn (MJS) launches—on Titan Centaurs—are scheduled at Kennedy in August. The two spacecraft will be instrumented to obtain data on the environments and atmospheres of Jupiter and Saturn, with emphasis on Saturn's rings. Flight time to Jupiter will be more than a year and a half and the trip to Saturn will take more than three and a half years.

Landsat-C, scheduled for launch from the Western Test Range on a Delta in September, is NASA's third Earth resources satellite to expand worldwide collection of Earth resources data.

The first two of three International Sun Earth Explorers, jointly sponsored by NASA and ESA, will be launched on a Delta from KSC in November. ISEE-A is a NASA spacecraft and ISEE-B was developed by ESA. Shortly after launch, ISEE-B will separate from ISEE-A and become active. The two spacecraft will be inserted into an orbit with an initial perigee of about 1,290 kilometers (800 miles) and an apogee of 23 Earth radii, or about 146,450 km (91,000 mi.). The ISEE-B spacecraft will be maneuvered at various times to fixed distances of about 96, 965 and 4,830 km (60, 600 and 3,000 mi.) from ISEE-A, remaining in each orbit from one to three years. During their multi-year missions the two spacecraft will investigate solar-terrestrial relationships at the outermost boundary of the Earth's magnetosphere and examine solar wind near Earth and the shock wave that forms the interface between the solar wind and the Earth. ISEE-C is scheduled for launch in 1978.

FLTSATCOM-A (Fleet Satellite Communications-A), the first of five geosynchronous orbiting satellites for a U.S. Navy worldwide communications satellite system, is scheduled for launch on an Atlas Centaur from KSC in September.

CS/Japan, a Japanese geosynchronous communications satellite to provide domestic telephone and color television transmissions, will be launched on a Delta in November from KSC.

IUE-A, a NASA interplanetary spacecraft to measure ultraviolet radiation, is scheduled for launch aboard a Delta rocket from Kennedy in December.

Two more launches are tentatively scheduled for 1977. The first is the UK-6. This high energy physics and astronomy satellite would be launched by a Scout rocket from the Wallops Flight Center, Va., for the United Kingdom. The second is RCA-C, a third domestic communications satellite that will be launched in September if required by RCA.

Mississippi Visit—The U.S. Civil Service Commission's vice chairperson Georgiana Sheldon recently visited NASA's National Space Technology Laboratories in Bay St. Louis. She is shown standing next to Jerry Hlass, NSTL manager (left) and Ann Westendorf, acting coordinator for Federal Women's Programs. Henry Auter, NSTL deputy manager, is at right. Sheldon answered questions about the Commission and described Commission activities for NSTL employees.

Launch Processing System for MFSC—Seated at the console of a launch processing system designed to check out components of the Space Shuttle's solid rocket boosters, Bobby J. Johnson of the Marshall center's test lab demonstrates how the system will work. The system was designed and built by the Kennedy Space Center, and it eventually will be returned there for use in checkout of the flight solid rocket booster. KSC director Lee Scherer (left) officially turned the system over to MFSC and center director Dr. William R. Lucas (hand extended) accepted. The fourth person in the photograph is Henry Paul, Kennedy's director of launch processing systems development.

Space Age Antique—The last of the Saturn 5 flight hardware, an S-II stage, is hoisted from its cell in the vehicle assembly building to make way for the Space Shuttle. The stage was later placed in a horizontal position on the S-II transporter in the center of the transfer aisle of the building, to await further disposition.

Cold-Stunned Sea Turtles Warmly Welcomed at NASA Center

Reacting to abnormally low temperatures in January, 140 cold-paralyzed sea turtles—green, loggerhead and one Atlantic Ridley species—surfaced on the waters or were beached on the shores of Mosquito Lagoon and the Indian and Banana Rivers near the Kennedy Space Center. Concerned citizens, local biology scientists and students carried the giant reptiles to the Florida Technological University laboratory, which is located at the northern end of the Kennedy center.

At first the animals were confined in small wading pools while their rescuers waited in vain for temperatures to rise and permit a quick return of the turtles to their natural habitat in nearby waters. Continued cold made it necessary that many of the turtles, particularly the larger ones, be moved to more satisfactory, less confined quarters. Accordingly, more than 100 of the specimens were placed in a 55-meter (180-foot) diameter, 2.4 m. (eight-foot) deep swimming pond in the recreation area located at the south end of KSC. The pond is fed by artesian springs; temperature is about 19 degrees C, satisfactory for survival of the turtles. The freshwater in the pond can support turtle life for limited periods; if need be, brackish water can be introduced from nearby lagoons. Small specimens remained in the wading pools.

Dr. L. M. Ehrhart, an animal ethologist at FTU, said the turtles were to be held in captivity for about two weeks until rising water temperatures permitted their return to surrounding estuaries, in early February. (FTU has a contract with KSC to conduct a baseline ecological study of the Spaceport.)

Ehrhart pointed out that the Atlantic Ridley turtle is on the endangered species list and the greens and loggerheads are candidates for the same designation. The arrival of an Atlantic Ridley, therefore, was called a real find and wildlife experts also were delighted at the unexpectedly large number of green turtles in the group. The potential size of the local population as projected on the basis of the numbers of animals recovered in the Florida episode far exceeds the population estimates of wildlife authorities, particularly for green turtles. Of the lot at the Kennedy center site, 80 percent of the total were green turtles.

The unusually low temperatures of 0 to 5 degrees C. (in the low 20s F. on land and 39 degrees F. in nearshore Florida waters) were catastrophic for fish species such as jacks, pompano, sailfish, and snook, but a bonanza for turtle investigators. For the past two years, for instance, FTU personnel had been attempting to net and tag turtles in waters near the Kennedy center, but until the January incident netters had caught and tagged only eight turtles. All but 10 of the turtles came from Mosquito Lagoon, which lies on the northeast side of the space center.

Wildlife "Find" in Florida—Inspecting three of 140 sea turtles that came ashore near the Kennedy center as a result of unexpected cold weather last January are (left) Dr. L. M. Ehrhart of Florida Technological University and Robert Yoder, manager of the Merritt Island National Wildlife Refuge, established on NASA land not in operational use. Species are identified as (l. to r.): an Atlantic Ridley, a green, and a loggerhead. Yoder said the reptiles surfaced after they were almost anesthetized by the plunging water temperatures.

Turtle Rescue Operations—Three of a collection of sea turtles that recently were delivered to the Kennedy Space Center are urged into the warm waters of a swimming pool at the Kennedy recreation area.

New NASA Publications

The Supernova, EP-126, is a publication of the Office of Public Affairs. The 40-page booklet, like three companion items (EP-127, EP-128 and EP-129) was prepared for secondary school science teachers in cooperation with the American Astronomical Society. It discusses in non-technical language the most spectacular event in the life of a star, related objects, and their importance in astronomy. The brochure is for sale by the U.S. Government Printing Office for $1.30.

Chemistry Between the Stars, EP-127, is a 60-page booklet prepared in cooperation with the American Astronomical Society. Designed for use and interpretation by secondary school science teachers, the technical booklet describes the nature of interstellar space, the physical conditions, kinds of molecules found, methods of identifying molecules, energy radiation, dust and gas clouds, "star factories" and the like. For sale by the U.S. Government Printing Office for $1.60.

Atoms in Astronomy, EP-128, is a 30-page booklet prepared in cooperation with the American Astronomical Society for use by secondary school science teachers. Astronomical spectroscopy is the subject. The first section of the book deals with basics, in non-technical language. The second section becomes semi-technical as it deals with intermediate and advanced topics. Most of the content is about electromagnetic radiation and atomic physics knowledge required to understand astronomical applications. The brochure is for sale by the U.S. Government Printing Office for $1.20.

Extragalactic Astronomy, EP-129, is a 40-page booklet prepared in cooperation with the American Astronomical Society for use by secondary school science teachers. The non-technical booklet introduces the student to the exciting discoveries of modern astronomy beyond the Milky Way galaxy, including: extragalactic radio sources, exploding galaxies, quasars, cosmic microwave background radiation and extragalactic X-ray sources. The brochure is for sale by the U.S. Government Printing Office for $1.30.

Did You Know?

In the fifth busiest year in the history of tours at the Kennedy Space Center, 1,137,367 visitors participated in guided bus tours during 1976. The total was 2.6 percent below the 1,168,189 people who took the tour in 1975. Since 1966, 10,372,729 people have taken tours of the Kennedy center and the adjacent Cape Canaveral Air Force Station. The peak year was 1972, near the end of the Apollo program.

Rockwell International, Space Division, is the recipient of a supplemental agreement to the Shuttle Orbiter contract. The value of the procurement action by NASA is $10 million. The agreement incorporates nine contract changes previously authorized by NASA for configuration changes to the orbiter for the approach and landing test, changes in definition of a quarter-scale ground vibration test model, and additional simulation efforts to cover support of orbiter 102, the first to be launched into space. The supplemental agreement brings the estimated value of the basic Shuttle contract to $3.038 billion.

NASA's fire losses for fiscal year 1976 set a new low record for the agency of only $41,000 in damages. Administrator Dr. James C. Fletcher sent memoranda to all center directors, commending them for their part in keeping losses so low. "Considering the nature of our activities, operations, facilities and missions, this is an accomplishment in which we take great pride," he said.

United Space Boosters, Inc. of Sunnyvale, Calif. has been chosen by NASA as the assembly contractor for the Space Shuttle solid rocket booster. The company is a wholly owned subsidiary of the United Technologies Corporation. The cost-plus-award-fee contract, worth $122 million including the maximum potential award fee, is for six flights covering design, development, test and evaluation extending through March 1980. Options cover 21 operational flights to 1982. The contract is for necessary activities to be completed at the Marshall and Kennedy centers.

Guided bus tours at the Marshall Space Flight Center in 1976 were taken by 95,529 visitors, an 11 percent increase over figures for the previous year. Visitors from all 50 states and several foreign countries took the tours, co-sponsored by the Marshall center and the Alabama Space and Rocket Center.

January 31 marked the 19th anniversary of the launching of America's first Earth satellite, Explorer 1. The 13.8-kilogram object, shaped like a stovepipe, 15 centimeters in diameter and 200 cm. long, carried the U.S. and the western world into the age of space. Explorer 1's principal scientific achievement was a major one—the discovery of the Van Allen Radiation Belts surrounding the Earth. The satellite was launched by a Jupiter-C rocket provided by the Army Ballistic Missile Agency, the predecessor agency to the Marshall center. ■■■

New Line-up at the Johnson Space Center

Richard S. Johnston recently was appointed to the new post of director of Space and Life Sciences following the merger of the Science and Applications and Applications and Life Sciences directorates at JSC. Johnston was director of life sciences at JSC from 1972 to early 1976.

Peter J. Armitage is the new assistant director for plans and programs. Dr. Lawrence F. Dietlein is assistant director for life sciences and Dr. Owen K. Garriott is assistant director for science.

The new organization absorbs the five divisions in the directorates formerly entitled science payloads; space research and operations; bioengineering systems; Earth observations; and lunar and planetary sciences.

Johnston, 50, began his federal service in 1946 at the U.S. Naval Research Laboratory as a research chemist. In 1955 he transferred to the Navy's Bureau of Aeronautics. He joined NASA in 1959, working at the Langley center as environmental control system engineer on Project Mercury, and held various positions in the space agency until January 1976 when he accepted a job with private industry. He rejoined NASA's Johnson center in the fall of 1976.

Mutually Beneficial Refuse-burning Plant to be Constructed

NASA will join the city of Hampton, Va., in building a refuse burning, steam-energy production plant that will serve Hampton and four federal agencies in the Tidewater area. The plant will be the first such community facility jointly sponsored by a city government and federal agencies.

The idea for the plant originated during studies at NASA's Langley Research Center, which sought ways to make better use of potential energy sources and help improve the environment. The project was undertaken in response to Executive Order 11752, which encourages Federal cooperation with local governments in efforts to prevent and control pollution.

The plant will be able to consume about 70 percent of Hampton's solid waste, and all refuse from the Langley center, the Langley Air Force Base, the Army's Fort Monroe and the Veterans Administration Hospital in Hampton. It will cost about $8 million. Some 60 percent of the cost will be paid by the city of Hampton, about 30 percent by NASA and the remaining 10 percent by the Langley Air Force Base. Cost of design and construction of the plant should be amortized within 20 years.

The new plant will:

- greatly extend the life of Hampton's present sanitary landfill, and eliminate the area's federal landfill;
- improve the environment by providing a more acceptable means of refuse disposal. Surface and sub-surface water contamination problems are aggravated by the fact that existing landfill sites are less than 4.3 meters (15 feet) above sea level;
- save the city of Hampton about $150,000 a year through the sale of energy produced by the plant to the Langley center's steam heating system;
- same some 2 to 2.5 million gallons of fuel oil each year, which at present must be purchased by the Langley center for its steam system.

The plant will be built on NASA-owned land and will remain the property of NASA, but it will be leased to and operated by the city of Hampton for at least 20 years. Technical proposals have been solicited from construction contractors. Final bids will be requested next spring, and a design and construction contract should begin in June 1977. The plant should be in operation by late 1979.

Essentially the plant is a special incinerator that reduces solid waste to sterile ash through high-intensity heating to 900 degrees C. (1,800 degrees F.). The ash is environmentally clean (non-organic and non-polluting) and will amount to only about one-seventh of the solid refuse. The plant will contain two boilers, each capable of burning 100 tons of refuse a day and converting the energy to steam. About 306 million pounds of steam will be produced each year.

During a seven-day week, refuse delivered to the plant will amount to about 175 tons a day from Hampton and 25 tons a day from the four Federal installations. The plant will accept all standard household refuse except items such as appliances and furniture. These kinds of non-organic refuse, plus the sterile ash from the plant, will continue to be disposed of at the Hampton landfill.

New Assistant Administrator Appointed

R. D. Ginter, a 17-year veteran with NASA, recently became Assistant Administrator for Energy Programs. The appointment followed a year and a half as Acting Assistant Administrator after the departure of scientist-astronaut Harrison H. Schmitt. (Schmitt is now a U.S. Senator.)

In his new post, Ginter directs the agency's efforts to apply aeronautics and space technology to the discovery, production, conversion, transmission, storage, conservation, utilization and management of energy here on Earth.

Ginter was born in Newton, Kansas, and earned his B.S. degree in aeronautical engineering at the University of Kansas (Lawrence) in 1948. He attended George Washington University in Washington, D.C., as a post-graduate student in engineering administration.

He came to NASA in 1960 as chief of the Scout launch vehicle program after eight years as a missile project officer with the U.S. Navy. He has served in a variety of positions at NASA, including posts as director of the technology applications division and director of the energy systems division. Ginter received NASA's Exceptional Service Medal in 1966 for his work as program manager for the Atlas Centaur launch vehicle.

Virginia Farmers Receive Help from Space

Farmers soon may be depending on space flight techniques to tell them the best time to apply insecticides, herbicides, fertilizers and irrigation needed to increase and maintain maximum production of many field crops now being grown under less precise crop-management practices.

Under a joint program funded by NASA's Wallops Flight Center, the Virginia Polytechnic Institute and State University at Blacksburg is constructing and will manage a network of data collection stations throughout the state of Virginia that will feed agro-environmental information to a central computer located at Blacksburg.

The experiment, known as the Agro-environmental Monitoring Project, involves the integration of remotely collected bits of information into an automated data management network. It is a direct result of knowledge gained from NASA's automated data collection and processing systems developed for that agency's satellite and space exploration programs.

Data collected from five monitoring stations located throughout the state will be processed into a mathematical crop-management model that will determine the correct timing and amount of insecticides, herbicides, fertilizers and irrigation water required for maximum results.

Dr. Norris L. Powell, principal investigator from VPI and SU, says that the possibility of pinpointing the times of disease and insect emergence is of paramount importance to the farmer. At present, a farmer must spray over a span of days or even weeks to protect his crops from such problems.

The new system will automatically keep track of the "degree-day" units that eventually will produce certain insect populations or diseases. When a number estimated as a sufficiency is reached, a "red flag" signal will be sent, notifying the farmer that his crop should be sprayed. The elimination of wasteful spraying during less effective periods should result in a cash return to the farmer in the form of lessened use of insecticides, reduced costs for labor and equipment, and lower pollution levels. Information on the application of fertilizer and supplemental irrigation will be handled similarly. Because computers can update data as rapidly as the information is processed, prediction of planting dates, crop maturity and yield also may be provided under the program. Dr. Powell expects many crop scientists to use information derived from the system to help solve other research questions.

Loyd C. Parker, the project manager at Wallops, said design work has been completed and all hardware will be acquired in time to provide five environmental monitoring stations and a central computing station by early spring.

The monitoring stations will contain various sensors that feed information into a microprocessor (small computer) at 15-minute intervals for systematic storage. The central computer will interrogate each of the microprocessors once every 24 hours and update daily each of the crop management models.

Monitoring stations will be located at agricultural experiment stations throughout the state—at Painter, Holland, Blackstone, Warsaw and Orange. Station scientists will provide backup information by direct "touch tone" telephone input to the central computer. Farmers in participating areas also will be asked to supply additional information concerning local conditions and cultural practices.

Farm Environment to be Monitored—This is not an ultra-modern telephone booth, but a remote agro-environmental monitoring station located at the Tidewater Research and Continuing Education Center in Holland, Va. It will keep farmers informed on a daily basis about a variety of factors affecting farm production.

Satellite Imagery Produces Photo Album of the World

The most comprehensive and detailed "space photo album" of the world's natural and cultural features has been prepared, using images from NASA's Landsat Earth resources satellite.

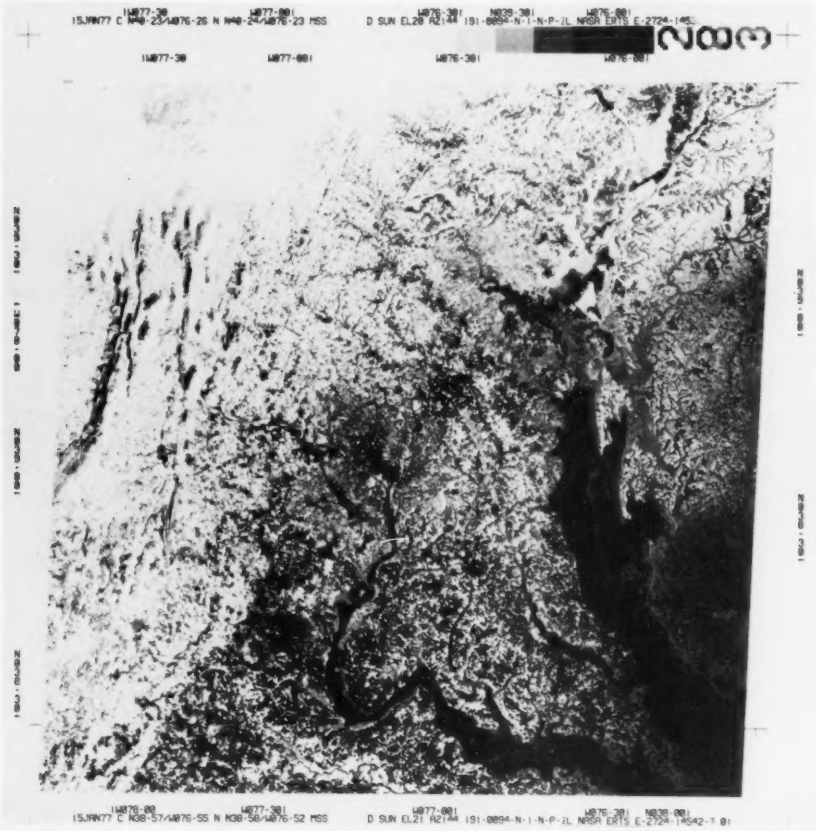
Entitled "Mission to Earth: Landsat Views the World," (SP-360), the atlas-sized publication contains some 400 Landsat images, most of them large and in color.

Landsat images are used extensively by scientists around the world as a tool in monitoring crop yields, mapping terrain features, and detecting urban area growth for census applications. Others use the imagery as an aid in mineral and fuel exploration, water resource monitoring and control, and inventoring strip-mining operations as well as flood and pollution damage.

Authors of the new book are Drs. Nicholas M. Short, Paul D. Lowman, Jr., and Stanley C. Freden of NASA's Goddard Flight Center and Dr. William A. Finch, Jr., of San Diego State University. They designed the book for wide readership appeal. It is a reference atlas, a teachers' guide, a textbook and a supplemental tool for the resource specialist.

Mission To Earth depicts the world with representative images, but preferential coverage is given to the United States. Approximately 40 percent of the images are devoted to regions within the 50 states.

In the preface, the authors assess the U.S. portion: "This book presents outstanding views of the vastness and variety of our country—the wooded Appalachians and industrial lowlands of the East, the rolling glacial hills and scattered lakes of the North



The Nation's Capital and Environs under Cold-Weather Siege —A Landsat-2 photograph taken in January shows Washington, D.C. (slightly left of center); Baltimore (upper center); Chesapeake Bay (top to bottom, right of center); Potomac and Rappahannock Rivers (bottom); Fredericksburg, Va. (extreme bottom center); Dulles Airport (left center); Cambridge, Md. (far right); and Chester River (upper right), all covered with ice and snow.

Country, the pine forests and savannas of the South, the prairies and farms of the Midwest and the Great Plains States, the western mountains and desert basins from Canada to Mexico, and the rugged coastlines along the Pacific Ocean."

The heart of the book consists of a variety of Landsat mosaics, montages, enlargements and standard images. In some cases the standard images have been repeated to reflect seasonal changes. Standard Landsat images cover 185 kilometers (115 miles) square and encompass about 34,000 square km (13,000 square mi.).

One special feature of *Mission to Earth* is the use of expanded captions to summarize the basic story present in each of the book's images. Each caption describes many well-known geographic points of interest in a scene, the main urban and cultural features, the major farming and industrial activities of the region and the characteristic natural vegetation. Various aspects of the geology seen in the pictures are described.

In addition to containing a "main picture gallery" section, *Mission to Earth* includes a comprehensive introduction to the Landsat spacecraft and its systems. One section provides a broad review of Landsat accomplishments and applications.

Because the book is considered to be of major value to educators, an "Educators' Guide" is being prepared by the Goddard center, to be provided at no cost, on request to the center's Office of Public Affairs, Educational Programs, Greenbelt, Md. 20771.

Among other things, the guide contains a "Teacher's Resource Section" which includes advice as to classroom activities, exercises and techniques for using the imagery. This section is organized around several major disciplines, including Earth science, geography and social studies. To facilitate the use of *Mission to Earth* by teachers, the guide includes a glossary of terms related to geology and remote sensing used in the book.

The book will be available by early March, through the U.S. Government Printing Office, Washington, D.C. 20402, at $14 a copy. The stock number is 033-000-00659-4.

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) and Employer(s)	Title & NASA Docket	Patent No.	Installation
Joseph G. Thibodaux, Jr., NASA/LARC Donald J. Lewis, NASA/LARC	Solid Propulsion Rocket Motor and Method of the Same	4,000,682	LARC
Martial A. Honnell, Auburn Univ., Auburn, Ala.	Frequency Modulated Oscillator	4,003,004	MSFC
Gabriel R. Wallace, NASA/MSFC	Method of and Means for Testing a Tape Record/Playback System	4,003,084	MSFC
William E. Salter, Glenn D. Weathers, Sidney S. Gussow, Sperry Rand Corp. Huntsville, Ala.			
Phillip A. Studer, NASA/GSFC	Magnetic Bearing System	4,000,929	GSFC
Ronald M. Muller, NASA/GSFC	Method and Apparatus for Measuring Web Material Wound on a Reel	4,001,552	GSFC
Arthur G. Birchenough, NASA/LERC	Electronic Analog Divider	4,001,602	LERC
Albert Zlatikis, Univ. of Houston, Houston, Texas	Analysis of Volatile Organic Compounds	4,003,257	JSC

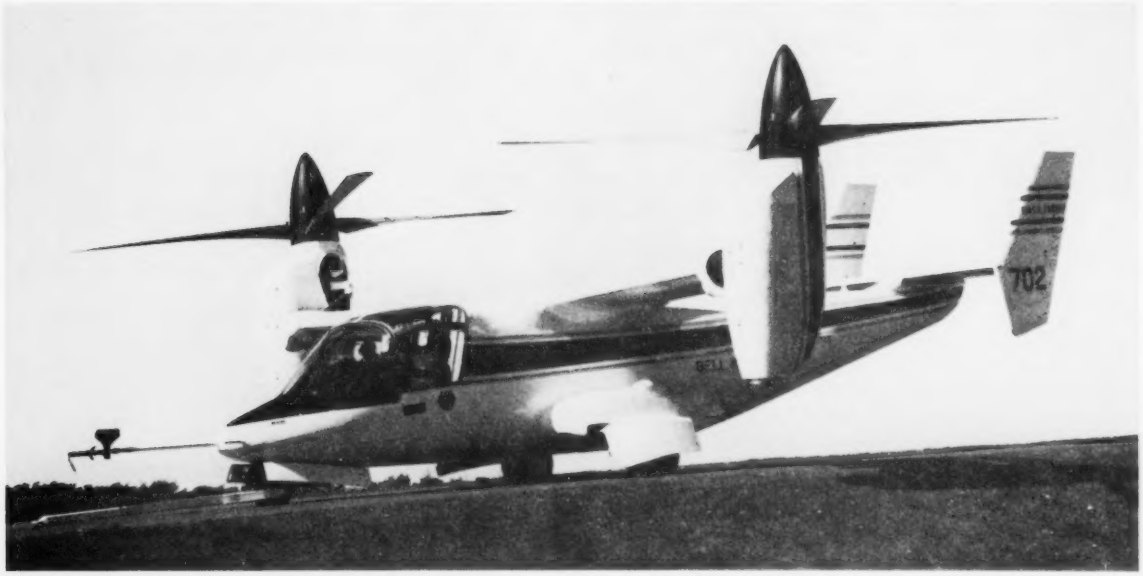
Radio-Television

Radio: Four weekly *Space Story* programs have been released, entitled "Public Technology Incorporated"; "The Interplanetary Yankee Clipper"; "Liquid Cooling Garment Technology"; "NASA and the Aircraft Transportation Industry." One monthly NASA *Special* Report has been released—" 'A' Is for Aeronautics: A Report on NASA's Aeronautical Research," featuring Dr. James J. Kramer.

Television: A 4½-minute and a 90-second film have been released in the *Aeronautics and Space Report* monthly series, entitled "Electric Car Research."

Award for Big Saving at Kennedy Center—Ocie Hill (left) receives NASA's Superior Achievement Award from Kennedy Space Center director Lee R. Scherer. The award was accompanied by a $2,500 award check. Hill, a printing specialist in the repro-graphics branch of the administrative operations and support services directorate, developed a plan for reproduction of half-size design drawings which, since its inception in 1975, has saved almost $2 million for the center. Previously design drawings were reproduced in full size.

Soviet Awards to Americans—Four Apollo Soyuz Test Project awards were given to Marshall center employees recently. The S. Korolev medal was presented to Harold Ledford, who was science and engineering chief engineer for ASTP. Yuri Gagarin diplomas were presented to Jewel W. Moody, Charles E. Cataldo and Paul H. Schuerer for chairing review teams after a cracked fin fitting was discovered during preflight inspection of the ASTP Saturn S-1B stage. Shown with center director W. R. Lucas (center) who presented the awards are (l. to r.) Schuerer, Moody, Ledford and Cataldo.



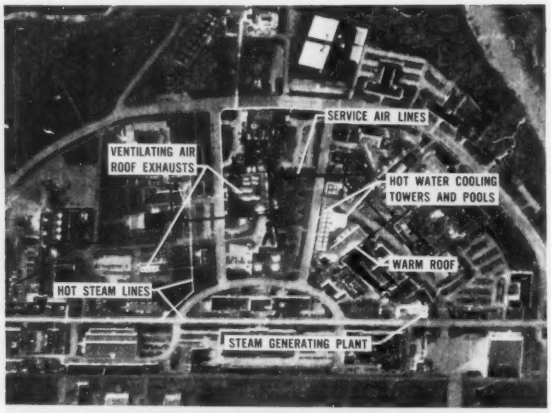
Experimental Aircraft—NASA's tilt rotor research aircraft is shown with its prop rotors in position for vertical take-off or landing. The unique aircraft was built under a joint research program combining the efforts of the Ames Research Center and the U.S. Army's Air Mobility R & D laboratory, both at Moffett Field, Calif. For forward flight, the prop rotors at the ends of the wings can be tilted forward so the rotors are positioned like aircraft propellers. This is the first of two aircraft being built by Bell Helicopter Textron, Fort Worth, Texas.

Are you getting your **1 cent** worth from **NASA**?

For a penny of your tax dollar, you are getting, among other things

A Measure of Home Heating Efficiency

Excessive loss of household heat puts a severe financial burden on homeowners and is a waste of precious natural gas. But how can one determine whether a home is losing too much heat? One answer is provided by technology now in use at NASA, which is being demonstrated this winter at the Lewis Research Center.



HEAT LOSS SURVEY OF NASA-LEWIS RESEARCH LABORATORY MADE BY LEWIS USING AIRBORNE THERMAL INFRARED SCANNER AT ALTITUDE OF 1000 ft. [HOT AREAS–WHITE, WARM AREAS–GRAY, COOL AREAS–BLACK]

The center is participating in the City of Cleveland's home winterization program by demonstrating the practicality of using an airborne infrared scanner to identify residential heat loss. At the request of Cleveland's Department of Community Development, Lewis personnel flew aircraft over demonstration residential areas on the east and west side of the city—areas that are eligible for three percent federally financed loans from HUD.

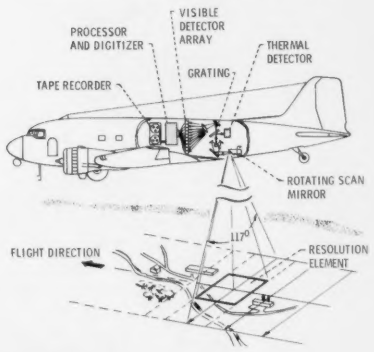
The infrared thermal scanning unit onboard Lewis' C47 aircraft flying at an altitude of 300 meters (1,000 feet) is able to view an .8-kilometer (half-mile) swath. Data are recorded on magnetic tape, later to be processed into picture-like images. They show hot areas as white, warm areas as gray and cool areas as black. It is possible, therefore, to determine which homes are losing undesirable amounts of heat by the degree of brightness of rooftops.

When the Cleveland demonstration flight was completed, residents of the target areas were notified that they might go to their local community center or other specified area to view the imagery and hear about the Cleveland winterization program. If the homeowner found that his home was losing inordinate amounts of heat, he was given the opportunity to apply for a low-interest block grant rehabilitation loan through the Department of Community Development.

Springfield, Ill., also asked the Lewis center to demonstrate the remote scanning system as part of the city's rehabilitation and winterization program accomplished in cooperation with HUD. NASA was reimbursed for its efforts, by both Cleveland and Springfield.

An energy conservation program has been in effect at all NASA centers for the past several years. Lewis has used the thermal infrared technique to scan all the NASA centers in the country, checking for energy loss from roofs, ventilator fans and central heating steam distribution lines. Findings and savings were impressive. At one center, for instance, savings amounted to $93,000 compared to a cost for the investigation of $7,000. Investigators claim that conventional testing would have cost about $100,000.

MODULAR MULTIBAND SCANNER IN C-47 AIRCRAFT



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